

NON-PUBLIC?: N
ACCESSION #: 9312020450
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Duane Arnold Energy Center PAGE: 1 OF 5

DOCKET NUMBER: 05000331

TITLE: Reactor Scram Due To Grounded Turbine Solenoid Valve
EVENT DATE: 10/26/93 LER #: 93-010-00 REPORT DATE: 11/19/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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Specialist

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On October 26, 1993, with the plant operating at 100% power, a full automatic reactor scram occurred. The scram signals were turbine control valve fast closure and average power range monitor high flux. An unknown ground at a turbine solenoid valve, combined with a momentary arc caused by maintenance on a fan in the electro-hydraulic control (EHC) cabinet in the control room, resulted in completion of the circuit to close one of the four turbine control valves.

All control rods inserted and vessel level dropped below the low level setpoint causing groups 2-5 primary containment isolations. Vessel level was restored and returned to normal. Reactor pressure was controlled by the turbine bypass - valves. There were no emergency core cooling system actuations and no safety relief valve openings.

The ground at the turbine solenoid valve was repaired and other turbine

valve circuits were checked for grounds but none were found. The reactor was re-started on October 28, 1993.

END OF ABSTRACT

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I. DESCRIPTION OF EVENT

On October 26, 1993 the plant was operating at 100% power. The B control building chiller was in day 7 of a 30 day administrative limiting condition for operation (LCO) and the low pressure coolant injection (LPCI) system was in day 2 of a 7 day planned maintenance LCO. Maintenance was in progress to replace a cooling fan on bay 4 of turbine electro-hydraulic control (EHC) cabinet 1C049 in the back panel area of the control room.

At 1831 hours, while a technician was attempting to disconnect the power leads to the existing cooling fan, a full automatic reactor scram occurred. Upon receipt of this reactor protection system (RPS) actuation, all control rods were verified to be fully inserted. A half scram on the turbine control valve (TCV) fast closure and a half scram on average power range monitor (APRM) high flux were the primary scram signals.

Following the scram, expected core void collapse caused indicated vessel level to drop below the 170 inch low level setpoint to a minimum of 135 inches. All required primary containment isolation system (PCIS) isolations, Groups 2-5, occurred when initiated by the 170 inch low level indication. Level then swelled due to reactor feedwater pump injection, eventually causing a feedwater pump trip at the 211 inch setpoint. Vessel level indication reached a high of 220 inches. Reactor water level was returned to normal using reactor water cleanup (RWCU) and then maintained using the A feedwater pump.

At 1835 hours the reactor scram was reset and level was returned to normal. At 1902 hours all PCIS Group isolations were reset and associated systems returned to normal. There were no emergency core cooling system (ECCS) actuations and no safety relief valve (SRV) openings during this event. Reactor pressure peaked at 1020 psig and was controlled by the turbine bypass valves. The reactor was re-started on October 28, 1993, after corrective actions were completed.

II. CAUSE OF EVENT

During troubleshooting following the scram, technicians found a ground

fault in EHC cabinet 1C049 that was traced to the fast acting solenoid valve that operates main turbine control valve CV3. A connector to the coil of the solenoid valve had a broken solder joint. This caused the coil of the solenoid valve to be shorted to ground while maintaining circuit continuity. The EHC cabinet cooling fan and the solenoid valve are on the same 115V AC neutral circuit. The pre-existing ground was unknown at the time of the scram. No definitive cause for the broken solder joint at the connector could be determined but use and age are suspected.

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When the technician replacing the cooling fan touched his pliers to the fan power lead, a momentary arc to the cabinet was created through the pliers. This arc momentarily completed the circuit through the solenoid valve due to the pre-existing ground discussed above (See Figure 1). This energized the solenoid valve resulting in a dump of the EHC hydraulic pressure. An RPS, channel A, half scram and CV3 partial closure occurred as designed.

The momentary closure of CV3 caused a pressure spike in the reactor which caused reactor power to increase due to void collapse. This reactor power increase was sensed by the B APRM resulting in a high flux RPS, channel B, half scram as designed. This completed the logic for a full RPS scram.

III. ANALYSIS OF EVENT

This event had no adverse effect on the safe operation of the plant. The reactor scram occurred as designed upon receipt of the TCV fast closure and APRM high flux signals. In addition to the B channel APRM high flux signal, the A channel APRM high flux scram signal was also received. All control rods fully inserted. Throughout the event, reactor vessel level and pressure were maintained within safe operating limits and the core thermal power limit was not exceeded. The plant is analyzed for this type of scram. All engineered safety features (ESFs) functioned as designed. There were no ECCS actuations or SRV openings. The broken solder joint at the solenoid valve had no effect on the operation of the turbine control system or any safety systems.

IV. CORRECTIVE ACTIONS

The replacement of the EHC cabinet cooling fan was completed the day following the scram. The connector to the coil of the solenoid valve was repaired by re-soldering. The ground was then verified to be cleared and CV3 was cycled satisfactorily.

To check for other possible ground faults in the turbine valve control circuits, 24 circuits were examined. These included the fast acting solenoid and test solenoid circuits of the turbine control valves, stop valves, and combined intermediate valves. No faults were found in any of these circuits.

Engineering evaluated the possibility of installing ground fault detection within these control systems but this was determined to be inappropriate. This event serves as a reminder of the sensitivity of EHC maintenance. This sensitivity indicates that, if possible, EHC maintenance should be performed during an outage. If EHC maintenance must be done on line, a careful risk evaluation should be performed as provided for in current maintenance procedures.

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V. ADDITIONAL INFORMATION

A. Previous Similar Events

A review of DAEC LERs since 1984 identified the following related LERs:

LERs 91-03, 89-01, 89-11, 87-22 report EHC or TCV problems.
LERs 91-12, 90-16, 89-06, 87-27 report wiring or connector problems.

Four of these eight LERs report scrams but none of them are similar to this event by involving a pre-existing ground.

B. EHS System and Component Codes

Systems: Chiller-KM
LPCI-BO APRM-IG
PCIS-JM RWCU-CE
EHC-TG Feedwater-SJ
RPS-JC Turbine Bypass-JI

Components: Connector-CON Fan-FAN
Solenoid Valve-PSV Control Valve-FCV

This report is being submitted pursuant to 10CFR50.73(a)(2)(iv).

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Figure 1 omitted.

ATTACHMENT 1 TO 9312020450 PAGE 1 OF 1

Iowa Electric Light and Power Company

November 19, 1993

NG-93-4909

Mr. John B. Martin
Regional Administrator
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License DPR-49
Licensee Event Report #93-010

Gentlemen:

In accordance with 10 CFR 50.73 please find attached a copy of the
subject Licensee Event Report.

Very truly yours,

David L. Wilson
Plant Superintendent - Nuclear

DLW/JK/eah

cc: Director of Nuclear Reactor Regulation
Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D. C. 20555

NRC Resident Inspector - DAEC

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